APPENDIX A

STANDARD OPERATING PROCEDURES AND OTHER TECHNICAL INFORMATION FOR INSTRUMENTS OPERATED BY STI AT THE CRPAQS ANCHOR SITES

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A.1 INTRODUCTION

This appendix volume includes the Standard Operating Procedures (SOPs) and other technical information for the instruments operated at the CRPAQS Anchor sites by STI. The SOPs describe the measurement principals for each instrument and the detailed operating procedures used during CRPAQS. Some of these procedures have been subsequently improved. The SOPs included here are the versions actually used for most of the measurements. If readers are interested in using these SOPs in future projects, they should contact STI or the authors of the SOP to find out whether improved versions are available. For some instruments, the results of design and intercomparison tests are also included.

The SOPs (and related information) included and their locations in the Appendix are listed in **Table A.1-1** for continuous instruments and **Table A.1-2** for non-continuous instruments, data acquisition systems, and calibrators

Table A.1-1. SOPs for continuous measurement instruments.

ID	Appendix Section	Measured Parameter	Vendor/Model	Method
A	A.2	Light Scattering	Radiance Research M903 Nephelometer	Visible light scattering
G-1	A.3	$PM_{2.5}$ Black Carbon (1-wavelength)	Andersen Instruments AE1X Aethalometer	Light absorption @ 880 nm
G-2	A.3	$PM_{2.5}$ Black Carbon (7-wavelength)	Andersen Instruments AE3X Aethalometer	Light absorption @ 950 nm, 880 nm, 660 nm, 590 nm, 571 nm, 450 nm, 350 nm
H	A.4	$PM_{2.5}$ OC/EC Carbon	Rupprecht & Patashnick 5400 OC/EC	Thermal plateau vaporization of CO_2
I-1	A.5	Particle Sizing 0.3-10 µm, 16 channels	Climet Instruments Spectro.3 CI-500 OPC	Optical particle sizing and counting
I-2	A.5	Particle Sizing 0.1-2 µm, 8 channels	Particle Measuring Systems Lasair OPC	Optical particle sizing and counting
I-3	A.5	Particle Sizing 0.01-0.4 µm, 53 channels	TSI SMPS	Scanning mobility particle sizing and counting
J	A.6	PM_{10} Total Mass	Met One Instruments 1020 BAM	Beta ray attenuation
K	A.6	$PM_{2.5}$ Total Mass	Met One Instruments 1020 BAM	Beta ray attenuation
O	A.7	NO/NO_y	Thermo Environmental Instruments 42CY NO_y	Chemiluminescence with single external converter
P	A.8	O_3	Advanced Pollution Instrumentation 400A O_3	UV absorption at 254 nm
Q	A.9	$PM_{2.5}$ Nitrate	Rupprecht & Patashnick 8400N Nitrate	Thermal flash vaporization of NO_x
R	A.7	$HN0_3$	Thermo Environmental Instruments Dual Converter 42CY HNO_3	Chemiluminescence with dual external converters
T	A.10	$PM_{2.5}$ Sulfate	Rupprecht & Patashnick 8400S Sulfate	Thermal flash vaporization of SO_2
Y	A.11	SO_2	Thermo Environmental Instruments 43S SO_2	Pulsed UV fluorescence at 294 nm
b	A.12	PAN/NO_2	CECERT PAN/NO_2	Continuous luminol with chromatography

BAM = Beta attenuation monitor, CE-CERT = U.C. Riverside College of Engineering-Center for Environmental Research and Technology, OC/EC = Organic carbon/elemental carbon, OPC = Optical particle counter, SMPS = Scanning Mobility Particle Sizer, TSI = TSI Incorporated, UV = Ultraviolet

Table A.1-2. SOPs for non-continuous measurements and support systems.

ID	Appendix Section	Measured Parameter or Support System	Collection Method	Analysis Method
L	A.13	$PM_{2.5}$ Mass & Elements	DRI SFS with Teflon filter	Gravimetry, XRF
M	A.13	$PM_{2.5}$ Ions & Carbon	DRI SFS with denuder, quartz filter and NaCl impregnated cellulose backup filter	IC, AA, AC, TOR
U	A.14	Light Hydrocarbons	OGI canister	GC/FID
V	A.15	Heavy Hydrocarbons	DRI TENAX	GC/TSD/FID
W	A.16	$PM_{2.5}$ Organic Compounds	DRI Teflon coated glass fiber filter, PUF/XAD	GC/MS
X	A.17	Aldehydes	AtmAA DNPH	HPLC
c	A.18	Ion Size Distribution	DRI MOUDI with Teflon substrates 0.1-15 µm, 9 cuts	IC, AC
d	A.18	Carbon Size Distribution	DRI MOUDI with aluminum substrates 0.1-15 µm, 9 cuts	TOR
i	A.19	Denuder-difference HNO_3	DRI SGS with aluminum denuder, NaCl-impregnated cellulose filters	IC
j	A.19	Denuder-difference NH_3	DRI SGS with citric acid-coated glass denuder, citric-acid-impregnated cellulose filters	AC
	A.20	Data acquisition system	Serial and analog data	
	A.21	Calibration system	Environics 9100 Calibrator	
	A.22	Tower Carriages	Tower Systems	

AA = Atomic absorption, AC = Automated colorimetry, AtmAA = Atmospheric Assessment Associates, Inc., DNPH = 2,4-di-nitro phenylhydrazine, DRI = Desert Research Institute, FID = Flame ionization detector, GC = Gas chromatography, HPLC = High pressure liquid chromatography, IC = Ion chromatography, MOUDI = Micro-Orifice Uniform Deposit Impactor, MS = Mass spectroscopy, OGI = Oregon Graduate Institute, PUF/XAD = Polyurethane foam plug and polystyrene-divinylbenzene resin , SFS = Sequential Filter Sampler, SGS = Sequential Gas Sampler, TOR = Thermal optical reflectance, **TSD = ,** XRF = X-ray fluorescence.

APPENDIX A.2

STANDARD OPERATING PROCEDURE, INSTRUMENT CHECK SHEET, AND INSTRUMENT INTERCOMPARISON TEST RESULTS
FOR
MEASUREMENT ID A
LIGHT SCATTERING
RADIANCE RESEARCH M903 NEPHELOMETER

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APPENDIX A.3

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID G-1 AND G-2
$PM_{2.5}$ BLACK CARBON (1-WAVELENGTH AND 7-WAVELENGTH)
ANDERSEN INSTRUMENTS AE1X AND AE3X AETHALOMETERS

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APPENDIX A.4

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID H
$PM_{2.5}$ OC/EC
RUPPRECHT & PATASHNICK 5400 OC/EC

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APPENDIX A.5

**STANDARD OPERATING PROCEDURES AND INSTRUMENT CHECK SHEETS FOR
MEASUREMENT ID I-1, I-2, AND I-3
PARTICLE SIZING INSTRUMENTS
CLIMET INSTRUMENTS SPECTRO .3 CI-500 OPC,
PARTICLE MEASURING SYSTEMS LASAIR OPC, AND
TSI SMPS
(INCLUDES INSTRUMENT COMPARISONS AND SELECTION RECOMMENDATIONS)**

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APPENDIX A.6

STANDARD OPERATING PROCEDURES AND INSTRUMENT CHECK SHEETS FOR MEASUREMENT ID J AND K PM_{10} AND $PM_{2.5}$ TOTAL MASS MET ONE INSTRUMENTS 1020 BAM

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APPENDIX A.7

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID O AND R
NO/NO_y AND HNO_3
THERMO ENVIRONMENTAL INSTRUMENTS 42CY NO_y
(SAME SOP IS USED FOR BOTH INSTRUMENTS)

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APPENDIX A.8

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID O
OZONE
ADVANCED POLLUTION INSTRUMENTATION 400A

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APPENDIX A.9

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID Q
$PM_{2.5}$ NITRATE
RUPPRECHT & PATASHNICK 8400N NITRATE

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APPENDIX A.10

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID T
$PM_{2.5}$ SULFATE
RUPPRECHT & PATASHNICK 8400S SULFATE

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APPENDIX A.11

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID Y
SO_2
THERMO ENVIRONMENTAL INSTRUMENTS 43S SO_2

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APPENDIX A.12

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID b
PAN/NO_2
CECERT PAN/NO_2

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APPENDIX A.13

STANDARD OPERATING PROCEDURES, INSTRUMENT LOG SHEETS, AND SPECIAL IOP INSTRUCTIONS
FOR
MEASUREMENT ID L AND M
$PM_{2.5}$ MASS & ELEMENTS AND $PM_{2.5}$ IONS & CARBON
DRI SFS

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APPENDIX A.14

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID U
LIGHT HYDROCARBONS
OGI CANISTER SAMPLER

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APPENDIX A.15

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID V
HEAVY HYDROCARBONS
DRI TENAX SAMPLER

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APPENDIX A.16

STANDARD OPERATING PROCEDURE
FOR
MEASUREMENT ID W
$PM_{2.5}$ ORGANIC COMPOUNDS
DRI TEFLON COATED GLASS FIBER FILTER, PUF/XAD

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APPENDIX A.17

STANDARD OPERATING PROCEDURE AND INSTRUMENT CHECK SHEETS
FOR
MEASUREMENT ID X
ALDEHYDES
AtmAA DNPH CARTRIDGE SAMPLER

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APPENDIX A.18

STANDARD OPERATING PROCEDURE
FOR
MEASUREMENT ID c AND d
ION AND CARBON SIZE DISTRIBUTION
DRI MOUDI

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APPENDIX A.19

STANDARD OPERATING PROCEDURE
FOR
MEASUREMENT ID i AND j
DENUDER-DIFFERENCE HNO_3 AND NH_3
DRI SGS

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APPENDIX A.20

STANDARD OPERATING PROCEDURE
FOR
THE DATA ACQUISITION SYSTEM

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December 8, 1999

APPENDIX A.21

STANDARD OPERATING PROCEDURE
FOR
THE CALIBRATION SYSTEM
ENVIRONICS SERIES 9100 CALIBRATOR

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APPENDIX A.22

STANDARD OPERATING PROCEDURE
FOR
THE ANGIOLA TOWER CARRIAGE SYSTEM

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